

1 1. A process for optimizing transmission speeds on a distributed
2 transmission system which can support multiple upstream channels or logical
3 channels simultaneously, comprising:

4 1) gathering data about each cable modem (CM) in a group of CM
5 coupled to a a cable modem termination system (CMTS) through a
6 distributed transmission system;

7 2) dividing said group of CMs up into logical groups based upon CM
8 type and/or throughput ability;

9 3) creating an upstream channel or logical channel on said distributed
10 transmission system for each logical group of CMs, each upstream channel
11 having transmission characteristics optimized for a particular logical group
12 of modems; and

13 4) assigning the modems in each logical group to the upstream
14 channel created for that logical group.

1 2. The process of claim 1 further comprising the steps of monitoring the bit
2 error rate of transmissions from each CM, and if the bit error rate of any CM
3 becomes too high or too low relative to underperformance and overperformance
4 standards, respectively, sending a message to said CM whose bit error rate has
5 become too high or too low causing each said CM which is overperforming or
6 underperforming to switch to an upstream channel with a burst profile which is
7 compatible with the CM modem type and suitable for more efficient
8 communications of digital data between said CMTS and said CM.

1 3. The process of claim 1 further comprising the steps of monitoring the
2 byte error rate of transmissions from each CM, and if the byte error rate of any

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3 CM becomes too high or too low relative to underperformance and
4 overperformance standards, respectively, sending a message to said CM whose
5 byte error rate has become too high or too low causing each said CM which is
6 overperforming or underperforming to switch to an upstream channel with a burst
7 profile which is compatible with the CM modem type and suitable for more efficient
8 communications of digital data between said CMTS and said CM.

1 4. The process of claim 1 further comprising the steps of monitoring the
2 packet error rate of transmissions from each CM, and if the packet error rate of
3 any CM becomes too high or too low relative to underperformance and
4 overperformance standards, respectively, sending a message to said CM whose
5 packet error rate has become too high or too low causing each said CM which is
6 overperforming or underperforming to switch to an upstream channel with a burst
7 profile which is compatible with the CM modem type and suitable for more efficient
8 communications of digital data between said CMTS and said CM.

1 5. The process of claim 1 further comprising the steps of monitoring the
2 signal-to-noise ratio (SNR) of transmissions from each CM, and if the SNR of any
3 CM becomes too high or too low relative to underperformance and
4 overperformance standards, respectively, sending a message to said CM whose
5 SNR has become too high or too low causing each said CM which is
6 overperforming or underperforming to switch to an upstream channel with a burst
7 profile which is compatible with the CM modem type and suitable for more efficient
8 communications of digital data between said CMTS and said CM.

1 6. The process of claim 1 further comprising the steps of monitoring the
2 received power of transmissions from each CM, and if the received power of any

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3 CM at said CMTS becomes too high or too low relative to underperformance and
4 overperformance standards, respectively, sending a message to said CM whose
5 received power has become too high or too low causing each said CM which is
6 overperforming or underperforming to switch to an upstream channel with a burst
7 profile which is compatible with the CM modem type and suitable for more efficient
8 communications of digital data between said CMTS and said CM.

1 7. The process of claim 1 wherein step 1 comprises gathering data about
2 each modem's throughput ability by monitoring post registration upstream CM
3 data transmissions and determining the value for one or more of a plurality of
4 factors that indicate whether each said CM is overperforming or underperforming
5 the burst profile and throughput ability of the upstream channel upon which said
6 CM is transmitting, said factors including RS codeword error rate, SNR, received
7 power, bit error rate, byte error rate and/or packet loss rate, and creating and
8 directing said overperforming CMs to transmit upstream on one or more new
9 upstream channels with burst profiles which are suitable for more efficient
10 communication upstream by said overperforming CMs, and creating and directing
11 said underperforming CMs to transmit upstream on one or more new upstream
12 channels with burst profiles which are suitable for more efficient communication
13 upstream by said underperforming CMs.

1 8. The process of claim 1 wherein step 1 comprises gathering data about
2 each modem through a registration process and wherein step 2 comprises dividing
3 modems into logical groups by modem type as learned from said registration
4 process, and wherein step 1 further comprises gathering data about each
5 modem's throughput ability by monitoring post registration data transmissions
6 and determining the value for one or more of a plurality of factors that indicate

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7 whether said modem is overperforming or underperforming the burst profile and
8 throughput ability of the upstream upon which said modem is transmitting, and
9 wherein step 2 further comprising subdividing any logical group with one or more
10 modems which are overperforming or underperforming into overperforming and
11 underperforming logical subgroups, and wherein step 3 further comprises creating
12 one or more upstream channels with burst profiles tailored to the throughput
13 ability of said overperforming modems and wherein step 4 further comprises
14 assigning said overperforming modems to an upstream channel with a burst
15 profile tailored to the throughput ability of said overperforming modem(s), and
16 wherein step 3 further comprises creating one or more upstream channels with
17 burst profiles tailored to the throughput ability of said underperforming modems,
18 and wherein step 4 further comprises assigning said underperforming modems to
19 an upstream channel with a burst profile tailored to the throughput ability of said
20 underperforming modem(s).

1 9. The process of claim 1 wherein step 1 comprises gathering data about
2 each modem through a registration process and wherein step 2 comprises dividing
3 modems into logical groups by modem type as learned from said registration
4 process with DOCSIS 1.0 modems in one logical group and DOCSIS 1.1 modems in
5 another logical group and DOCSIS 2.0 modems in a third logical group operating in
6 SCDMA or ATDMA mode only, each logical group having created for it an
7 upstream having a burst profile suited to the throughput ability and modulation
8 profile of the modems in said logical group in step 3, and all modems in each
9 logical group being assigned in step 4 to an upstream having a burst profile
10 tailored to the modems in said logical group, and wherein step 1 further comprises
11 gathering data about each modem's throughput ability by monitoring post
12 registration data transmissions and determining the value for one or more of a

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13 plurality of factors that indicate whether said modem is overperforming or
14 underperforming the burst profile and throughput ability of the upstream upon
15 which said modem is transmitting, and wherein step 2 further comprising
16 subdividing any logical group with one or more modems which are overperforming
17 or underperforming into overperforming and underperforming logical subgroups,
18 and wherein step 3 further comprises creating one or more upstream channels
19 with burst profiles tailored to the throughput ability of said overperforming
20 modems and wherein step 4 further comprises assigning said overperforming
21 modems to an upstream channel with a burst profile tailored to the throughput
22 ability of said overperforming modem(s), and wherein step 3 further comprises
23 creating one or more upstream channels with burst profiles tailored to the
24 throughput ability of said underperforming modems, and wherein step 4 further
25 comprises assigning said underperforming modems to an upstream channel with a
26 burst profile tailored to the throughput ability of said underperforming modem(s).

1 10. The process of claim 1 wherein step 1 comprises gathering data about
2 each modem through a registration process and wherein step 2 comprises dividing
3 modems into logical groups by modem type as learned from said registration
4 process with DOCSIS 1.0 modems in one logical group and DOCSIS 1.1 modems in
5 another logical group and DOCSIS 2.0 modems grouped into a logical group
6 operating in SCDMA mode only and/or a logical group operating in ATDMA mode
7 only, each logical group having created for it an upstream channel having a burst
8 profile suited to the throughput ability and modulation profile of the modems in
9 said logical group in step 3, and all modems in each logical group being assigned in
10 step 4 to an upstream having a burst profile tailored to the modems in said logical
11 group, and wherein step 1 further comprises gathering data about each modem's
12 throughput ability by monitoring post registration data transmissions and

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13 determining the value for one or more of a plurality of factors that indicate
14 whether said modem is overperforming or underperforming the burst profile and
15 throughput ability of the upstream channel upon which said modem is transmitting,
16 and wherein step 2 further comprising subdividing any logical group with one or
17 more modems which are overperforming or underperforming into overperforming
18 and underperforming logical subgroups, and wherein step 3 further comprises
19 creating one or more upstream channels with burst profiles tailored to the
20 throughput ability of said overperforming modems and wherein step 4 further
21 comprises assigning said overperforming modems to an upstream channel with a
22 burst profile tailored to the throughput ability of said overperforming modem(s),
23 and wherein step 3 further comprises creating one or more upstream channels
24 with burst profiles tailored to the throughput ability of said underperforming
25 modems, and wherein step 4 further comprises assigning said underperforming
26 modems to an upstream channel with a burst profile tailored to the throughput
27 ability of said underperforming modem(s).

1 11. The process of claim 1

2 wherein step 1 comprises gathering data about each modem through
3 an initial ranging process and a registration process,

4 and wherein step 2 comprises dividing modems into logical groups by
5 modem type as learned from said registration process with DOCSIS 1.0
6 modems in one logical group and DOCSIS 1.1 modems in another logical
7 group and DOCSIS 2.0 modems in a third logical group operating in SCDMA
8 mode only or ATDMA mode only,

9 and wherein each logical group has created for it an upstream having
10 a burst profile suited to the throughput ability and modulation profile of the
11 modems in said logical group in step 3,

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12 and wherein all modems in each logical group being assigned in step 4
13 to an upstream channel having a burst profile tailored to the modems in
14 said logical group,

15 and wherein step 1 further comprises gathering data about the
16 received signal power and/or signal-to-noise ratio (SNR) of initial ranging
17 transmissions, and if any modem has inadequate received signal power
18 and/or signal to noise ratio after a plurality of attempts to correct the
19 problem, dividing said modems into one or more low power and/or high
20 power subgroups and/or one or more low SNR and/or high SNR subgroups
21 in step 2 and creating one or more lower throughput, more robust
22 upstream channels for each low power and/or low SNR subgroup in step 3
23 and sending messages to said modems that have low power and/or low
24 SNR directing said modems to switch to said one or more lower
25 throughput, more robust upstream channels, each lower throughput, more
26 robust upstream channel having a burst profile tailored to achieve reliable
27 communications with said modems in said low power and/or low SNR
28 subgroup assigned to said lower throughput, more robust upstream
29 channel such that registration can be completed, and creating one or more
30 higher throughput, less robust upstream channels for each high power
31 and/or high SNR subgroup in step 3 and sending messages to said modems
32 that have high power and/or high SNR directing said modems to switch to
33 said one or more higher throughput, less robust upstream channels, each
34 higher throughput, less robust upstream channel having a burst profile
35 tailored to achieve reliable communications with said modems in said high
36 power and/or high SNR subgroup assigned to said higher throughput, less
37 robust upstream channel such that registration can be completed;

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38 and wherein step 1 further comprises gathering data about each
39 modem's throughput ability by monitoring post registration data
40 transmissions and determining the value for one or more of a plurality of
41 factors that indicate whether said modem is overperforming or
42 underperforming the burst profile and throughput ability of the upstream
43 upon which said modem is transmitting,

44 and wherein step 2 further comprising subdividing any logical group
45 with one or more modems which are overperforming or underperforming
46 into overperforming and underperforming logical subgroups,

47 and wherein step 3 further comprises creating one or more upstream
48 channels with burst profiles tailored to the throughput ability of said
49 overperforming modems,

50 and wherein step 4 further comprises assigning said overperforming
51 modems to an upstream channel with a burst profile tailored to the
52 throughput ability of said overperforming modem(s),

53 and wherein step 3 further comprises creating one or more upstream
54 channels with burst profiles tailored to the throughput ability of said
55 underperforming modems,

56 and wherein step 4 further comprises assigning said underperforming
57 modems to an upstream channel with a burst profile tailored to the
58 throughput ability of said underperforming modem(s).

1 12. The process of claim 11 further comprising the step of continuing to
2 monitor post registration data communications and determining the values of one
3 or more factors that indicate whether a modem is overperforming or
4 underperforming, and if any modem is overperforming or underperforming its
5 upstream channel's throughput ability, creating a new logical subgroup and new

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6 upstream channel for said modem and assigning said modem to transmit on said
7 new upstream channel, said new upstream channel having a burst profile tailored
8 to make efficient use of the throughput ability of said modem.

1 13. A process for optimizing transmission speeds on a distributed
2 transmission system which can support multiple upstream channels simultaneously
3 and which has a plurality of cable modems coupled to said distributed system,
4 each having different upstream transmission modes, comprising:

5 transmitting one or more DOCSIS downstreams from a cable modem
6 termination system (CMTS);

7 for each DOCSIS downstream, transmitting:

8 an upstream channel descriptor message which
9 establishes a DOCSIS 1.0 upstream;

10 an upstream channel descriptor message which
11 establishes a DOCSIS 2.0 SCDMA or DOCSIS 2.0 ATDMA
12 upstream;

13 receiving initial ranging bursts from each of a plurality of cable
14 modems (CM) and processing said bursts to conduct initial training of each
15 CM which transmitted an initial ranging burst, and sending downstream
16 messages to each CM to cause any needed adjustments in power,
17 frequency, timing and/or equalization coefficients;

18 receiving registration transmissions from each CM which has
19 successfully completed initial ranging, and determining the type of each CM
20 from registration data;

21 creating a separate logical group for all DOCSIS 1.1 CMs and one or
22 more separate 1.1 upstream channels for said DOCSIS 1.1 cable modems,
23 each said 1.1 upstream channel having a burst profile tailored for the

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24 throughput ability of DOCSIS 1.1 CMs and linked to a downstream to which
25 a DOCSIS 1.1 CM is tuned, and sending downstream messages to each
26 DOCSIS 1.1 CM causing each DOCSIS 1.1 CM to switch to an 1.1 upstream
27 channel linked to the downstream to which said CM is tuned.

1 14. The process of claim 13 further comprising the steps of monitoring the
2 received power of each CM during initial training thereof, and, for any CM which has
3 inadequate received power after a plurality of attempts to adjust transmit power
4 of said CM have failed to cause said CM's signal to arrive at said CMTS with
5 adequate received power, causing said CM to switch to an upstream channel with
6 a burst profile which is compatible with the CM modem type and suitable for
7 adequate communications of digital data between said CMTS and CM despite said
8 power shortfall problem.

1 15. The process of claim 13 further comprising the steps of monitoring the
2 received power of each cable modem in each logical group during initial training,
3 and, if the received power from a CM is not adequate after a predetermined
4 number of tries to adjust the transmit power of said CM, then concluding said CM
5 has a power shortfall problem and either creating a low power, more robust
6 upstream channel with a burst profile suitable to allow adequately reliable
7 reception from said CM with said power shortfall problem and sending a message
8 to said CM with said power shortall problem so as to cause said CM with said
9 power shortfall problem to switch to said low power, more robust upstream
10 channel, or sending a message to said CM with said power shortfall problem so as
11 to cause it to switch to a low power, more robust upstream channel which already
12 exists and which is compatible with the type of DOCSIS modem said CM with said

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13 power shortfall problem is and which is linked to a downstream to which said CM
14 with said power shortfall problem is tuned.

1 16. The process of claim 13 further comprising the steps of monitoring the
2 signal to noise ratio of transmissions from each CM during initial training of said
3 CM, and if the signal to noise ratio of any CM is still unacceptable after multiple
4 attempts to complete initial training, sending a message to said CM whose signal
5 to noise ratio has become unacceptable causing said CM to switch to an upstream
6 channel with a burst profile which is compatible with the CM modem type and
7 suitable for adequate communications of digital data between said CMTS and CM
8 despite said inadequate signal to noise ratio problem.

1 17. A process for optimizing transmission speeds on a distributed
2 transmission system which can support multiple upstream channels simultaneously
3 and which has a plurality of cable modems coupled to said distributed system,
4 each having different upstream transmission modes, comprising:

5 transmitting one or more DOCSIS downstreams from a cable modem
6 termination system (CMTS);

7 for each DOCSIS downstream, transmitting:

8 an upstream channel descriptor message which
9 establishes a DOCSIS 1.0 upstream;

10 an upstream channel descriptor message which
11 establishes a DOCSIS 1.1 upstream;

12 an upstream channel descriptor message which
13 establishes a DOCSIS 2.0 upstream operating in SCDMA or
14 TDMA mode;

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15 receiving initial ranging bursts from each of a plurality of cable
16 modems (CM) and processing said bursts and sending downstream
17 messages to each CM to cause any needed adjustments in power,
18 frequency, timing and/or equalization coefficients;

19 receiving registration transmissions from each CM which has
20 successfully completed initial ranging, and determining the type of each CM
21 from registration data and sending any necessary downstream messages
22 to any CM that is transmitting on an upstream not having a burst profile
23 optimized for the modulation profile of said CM causing said CM to move to
24 an upstream having a burst profile optimized for the CM's modulation
25 profile;

26 monitoring the received power of each CM during initial training
27 thereof, and determining any CM which has inadequate received power or
28 inadequate signal-to-noise ratio after a plurality of attempts to adjust
29 transmit power of said CM have failed to cause said CM's signal to arrive at
30 said CMTS with adequate received power or adequate signal to noise ratio;

31 sending a downstream message to each CM which has inadequate
32 received signal power or signal-to-noise ratio to cause said CM to switch to
33 a lower throughput upstream channel with a burst profile which is
34 compatible with the CM type and suitable for adequate communications of
35 digital data between said CMTS and CM despite inadequate received signal
36 power or inadequate signal-to-noise ratio.

1 18. The process of claim 17 further comprises the steps of gathering data
2 about each modem's throughput ability by monitoring post registration data
3 transmissions and determining the value for one or more of a plurality of factors
4 that indicate whether said modem is overperforming or underperforming the burst

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5 profile and throughput ability of the upstream upon which said modem is
6 transmitting, and further comprising the step of subdividing any logical group with
7 one or more modems which are overperforming or underperforming into
8 overperforming and underperforming logical subgroups, and further comprising the
9 step of creating one or more upstream channels with burst profiles tailored to the
10 throughput ability of said overperforming modems, and further comprising the
11 step of assigning said overperforming modems to an upstream channel with a
12 burst profile tailored to the throughput ability of said overperforming modem(s),
13 and further comprising the step of creating one or more upstream channels with
14 burst profiles tailored to the throughput ability of said underperforming modems,
15 and further comprising the step of assigning said underperforming modems to an
16 upstream channel with a burst profile tailored to the throughput ability of said
17 underperforming modem(s).

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1 19. A process for optimizing transmission speeds on a distributed
2 transmission system which can support multiple upstream channels simultaneously
3 and which has a plurality of cable modems coupled to said distributed system,
4 each having different upstream transmission modes, comprising:

5 transmitting one or more DOCSIS downstreams from a cable modem
6 termination system (CMTS);

7 for each DOCSIS downstream, transmitting:

8 an upstream channel descriptor message which
9 establishes a DOCSIS 1.0 upstream;

10 an upstream channel descriptor message which
11 establishes a DOCSIS 2.0 upstream;

12 receiving initial training bursts from each of a plurality of cable
13 modems (CM) and deducing the cable modem type from the upstream upon

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14 which each said initial training burst was received thereby creating defacto
15 logical groups of cable modems grouped by modem type.
16 receiving registration communications from each CM;
17 after registration, receiving upstream data transmissions from each
18 CM;
19 monitoring one or more of the following parameters of
20 communication of data from each CM: the received power; the signal to
21 noise ratio; the bit error rate; the byte error rate; the Reed-Solomon
22 codeword error rate; and the packet error rate;
23 if performance of any CM becomes either too good or too bad, as
24 measured by comparing the monitored parameter for said CM to limits that
25 establish what performance level is too good or too bad, sending a
26 message to said CM to cause it to change to an upstream channel which
27 has a burst profile which is suitable for the CM's performance.

1 20. An apparatus comprising:
2 any DOCSIS compatible cable modem termination system having a
3 control computer programmed to carry out a process comprising the
4 steps:
5 receiving in a cable modem termination system (CMTS) registration
6 messages from each cable modem coupled to said CMTS and determining
7 the modem type from each registration message;
8 in said cable modem termination system assigning each cable modem
9 to a group based upon the modem type with DOCSIS 1.0 compliant
10 modems in a first group, DOCSIS 1.1 compliant modems in a second group,
11 DOCSIS 2.0 compliant modems in a third group;

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12 in said cable modem termination system, generating and transmitting
13 downstream to all said cable modems a plurality of Upstream Channel
14 Descriptor (UCD) messages, each UCD message establishing a logical
15 upstream channel to which one of the groups of modems will be assigned
16 and defining a burst profile for said logical upstream channel which is
17 appropriate for the group of modems that will be assigned to transmit on
18 that upstream logical channel;

19 generating in said cable modem termination system and transmitting
20 to each said cable modem which has registered a message which tells each
21 cable modem the upstream logical channel to which it has been assigned.

1 21. The apparatus of claim 20 wherein said control computer is further
2 programmed to carry out the steps of:

3 1) monitoring the received power from each cable modem in a group;
4 2) if the received power at said CMTS is less than a required value
5 for a cable modem, commanding said cable modem to increase its transmit
6 power in a downstream message and repeating steps 1 and 2 until said
7 cable modem's transmitted signal arrives at said CMTS at the required
8 power;

9 3) if after reaching its maximum power available, a cable modem's
10 upstream transmissions still do not arrive at said CMTS at the required
11 power level, subdividing said cable modem into a subgroup comprised of all
12 modems of the same type and whose signals do not arrive at said CMTS at
13 the required power level despite each said modem in said subgroup
14 transmitting at the maximum available power;

15 4) generating a UCD message for a new logical upstream to which
16 said modems in said subgroup will be assigned, said UCD message

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17 establishing a burst profile for said new logical upstream which is sufficiently
18 robust in its forward error correction, modulation type, symbol rate and/or
19 other burst parameters such that modems in said subgroup can transmit
20 upstream with an acceptable error rate.

1 22. The apparatus of claim 20 wherein said control computer is further
2 programmed to carry out the steps of:

3 monitoring the received power of each CM during initial training
4 thereof, and, for any CM which has inadequate received power after a
5 plurality of attempts to adjust transmit power of said CM have failed to
6 cause said CM's signal to arrive at said CMTS with adequate received
7 power, causing said CM to switch to an upstream channel with a burst
8 profile which is compatible with the CM modem type and suitable for
9 adequate communications of digital data between said CMTS and CM
10 despite said power shortfall problem.

1 23. The apparatus of claim 20 wherein said control computer is further
2 programmed to carry out the steps of:

3 monitoring one or more of the following parameters of
4 communication of data from each CM: the received power; the signal to
5 noise ratio; the bit error rate; the byte error rate; the Reed-Solomon
6 codeword error rate; and the packet error rate;
7 if performance of any CM becomes either too good or too bad, as
8 measured by comparing the monitored parameter for said CM to limits that
9 establish what performance level is too good or too bad, sending a
10 message to said CM to cause it to change to an upstream channel which
11 has a burst profile which is suitable for the CM's performance, and creating

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12 an new upstream channel with suitable burst profile if necessary to which
13 said CM whose performance is too good or too bad may be changed.

1 24. The apparatus of claim 20 wherein said CMTS has line cards which
2 receive upstream signals from upstreams on a plurality of data paths from
3 different cable nodes, and wherein said line cards have switches therein controlled
4 by said CMTS to gate bursts from said plurality of data paths to a controller, and
5 wherein control computer is further programmed to control said switch of any line
6 card coupled to a cable upon which a TDMA burst is expected to turn on during a
7 gap before said TDMA burst and turn off during a gap after said TDMA burst and
8 to keep all other switches of other line cards turned off such that only said
9 expected burst is gated through to said combiner, and wherein said control
10 computer is further programmed to control the switch of any line card coupled to
11 a cable upon which an SCDMA burst is expected to turn on during the ramp up of
12 said SCDMA burst and to turn off during a ramp down of said SCDMA burst and
13 to control other switches of other line cards to behave in the same way for
14 expected SCDMA bursts on cables coupled to said other line cards.